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VMetric

Spares Optimization and Data Management

A presentation for

MCLB

Albany, GA

22 February 2001

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What is Spares Optimization?

- At the core of supply chain management
- Aimed at determining the *best** answers to:
  - How many spares should we buy?
  - Where should we put them?
- A good tool will also provide answers to related questions
  - What is it worth to reduce shipping times?
  - What is it worth to reduce repair times?
  - How are current stock solutions changed if we move a hub or add (or close) a repair shop?
  - What will we need to support more operating bases?

* Best means satisfying a performance goal for the lowest cost

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Alternative Methods

- Rules of thumb – expensive and inadequate to support operations
- Single item modeling
  - Non-optimal (doesn't attempt to economize)
  - Recognizes only one maintenance level, one operating base and one hardware indenture level
    - I.e., provides no guidance for best geographic distribution of stock
- Modern optimal spares analysis
  - Seeks least-cost part mix *and* geographic distribution to accomplish operational goal(s)
  - Uses marginal analysis technique (what's the next best thing to do?)

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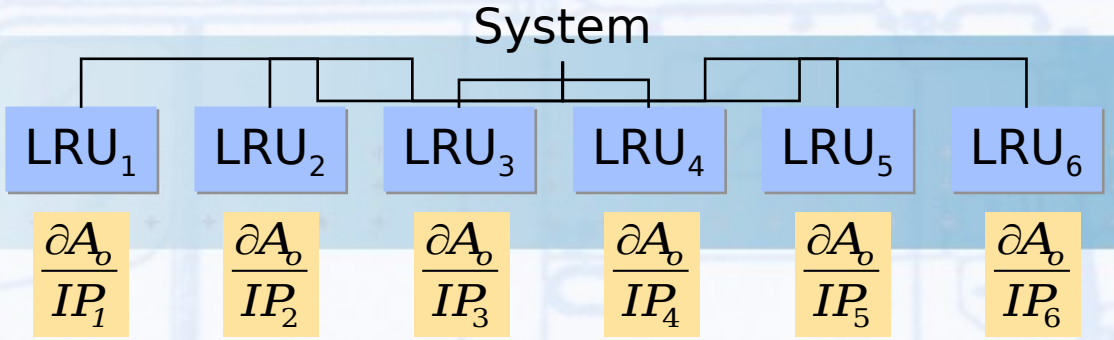
General Optimization Process

Step 1: Choose item with highest ratio
Step 2: Recompute ratio for that item
Step 3: Repeat steps 1 and 2 until target reached



Summary Reports : 'Methods Illustration Run' run for 'Methods Illustration' project

Reports

Sort

Ao vs Cost | By Part | By Site | Summary | System Structure | Net Benefit | Anomalies | Spares by Site | Summary by Site

Site Name	Item Name	Iter.	Total	Availability	Fill Rate	Total Cost	Slope
LHR	PRINTER	42	65	0.32190	0.17507	25232	2.50175E-06
LAX	PRINTER	43	66	0.32327	0.26849	25662	3.18097E-06
West Coast Shop	MODEM,MOD V.3225 RK	44	2	0.32509	0.26849	26094	4.20631E-06
DCA	PRINTER	45	67	0.32591	0.27500	26524	1.90889E-06
West Coast Shop	CPU BOARD	46	1	0.32851	0.27500	27523	2.59831E-06
DFW	PRINTER	47	68	0.32919	0.27782	27953	1.58488E-06
West Coast Shop	PRINTER	48	69	0.32980	0.28319	28208	2.38314E-06
West Coast Shop	SENSOR/COMM ASSY	49	1	0.34016	0.28319	30473	4.57505E-06
West Coast Shop	SENSOR/COMM ASSY	50	2	0.35052	0.28319	32738	4.57504E-06
West Coast Shop	SENSOR/COMM ASSY	51	3	0.36088	0.28319	35003	4.57501E-06
West Coast Shop	SENSOR/COMM ASSY	52	4	0.37124	0.28319	37268	4.57484E-06

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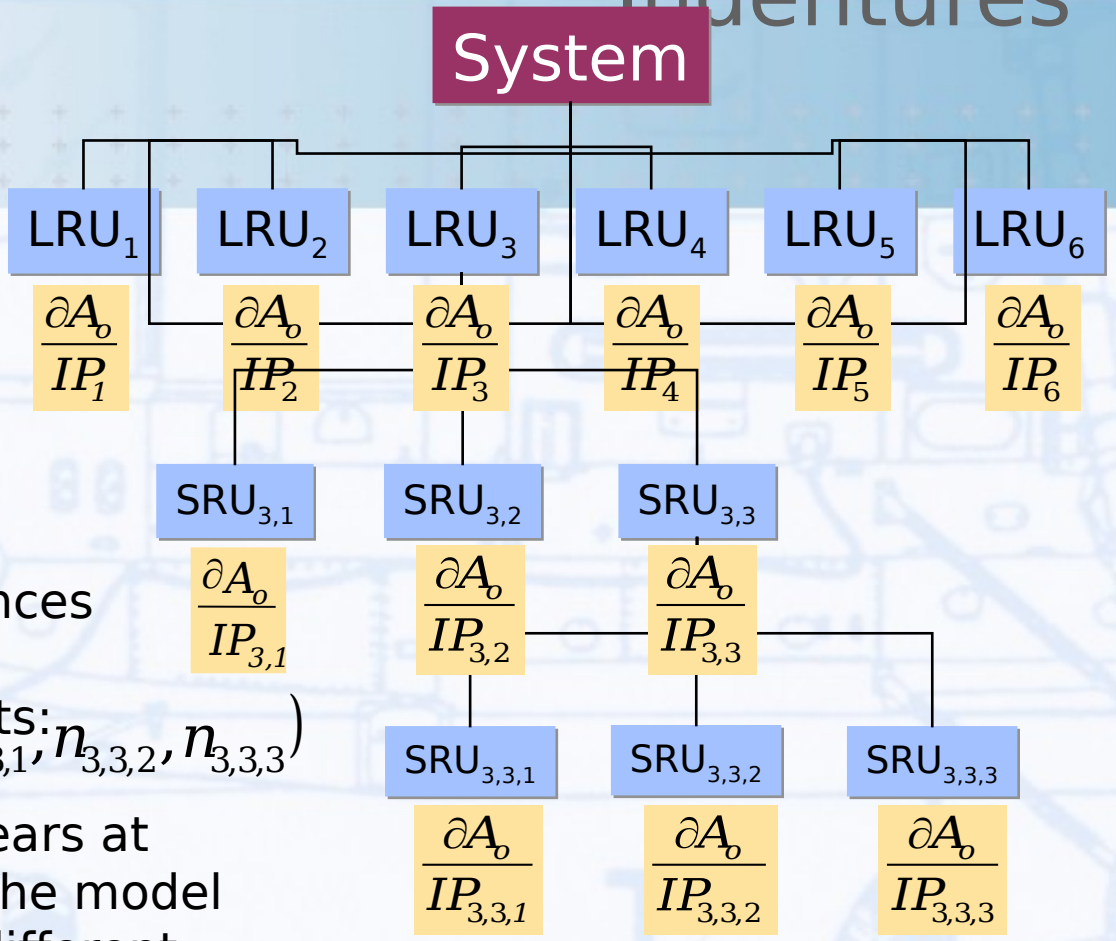
The Effect of Multiple Indentures



- A choice of a lower indenture item influences the value of the next choice of all its parents:

$$\partial A_o = g(n_{3,1}, n_{3,2}, n_{3,3} .. n_{3,3,1}, n_{3,3,2}, n_{3,3,3})$$

- If the same item appears at multiple indentures, the model must also adjust for different amounts of "LRUness"

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The Effect of Multiple Echelons

- For the "different base case" all those choices must be tried at every *site*, not just each echelon
- Multiple system types must
  - Resolve commonality across systems
  - Allow different objective functions for each system (e.g., A_o, fill rate, service level, delay time, shortage cost, B_o)
  - Different base cases must allow differences in
    - Number and types of systems assigned to each base
    - Operating programs for each system type at each base
    - Delay times faced by or characterizing each base or shop
      - Order and ship time
      - Procurement lead time
      - Repair cycle time
    - Stock constraints and component criticality by part at each site
    - Repair fraction (BCM and NRTS rate) differences by part and shop

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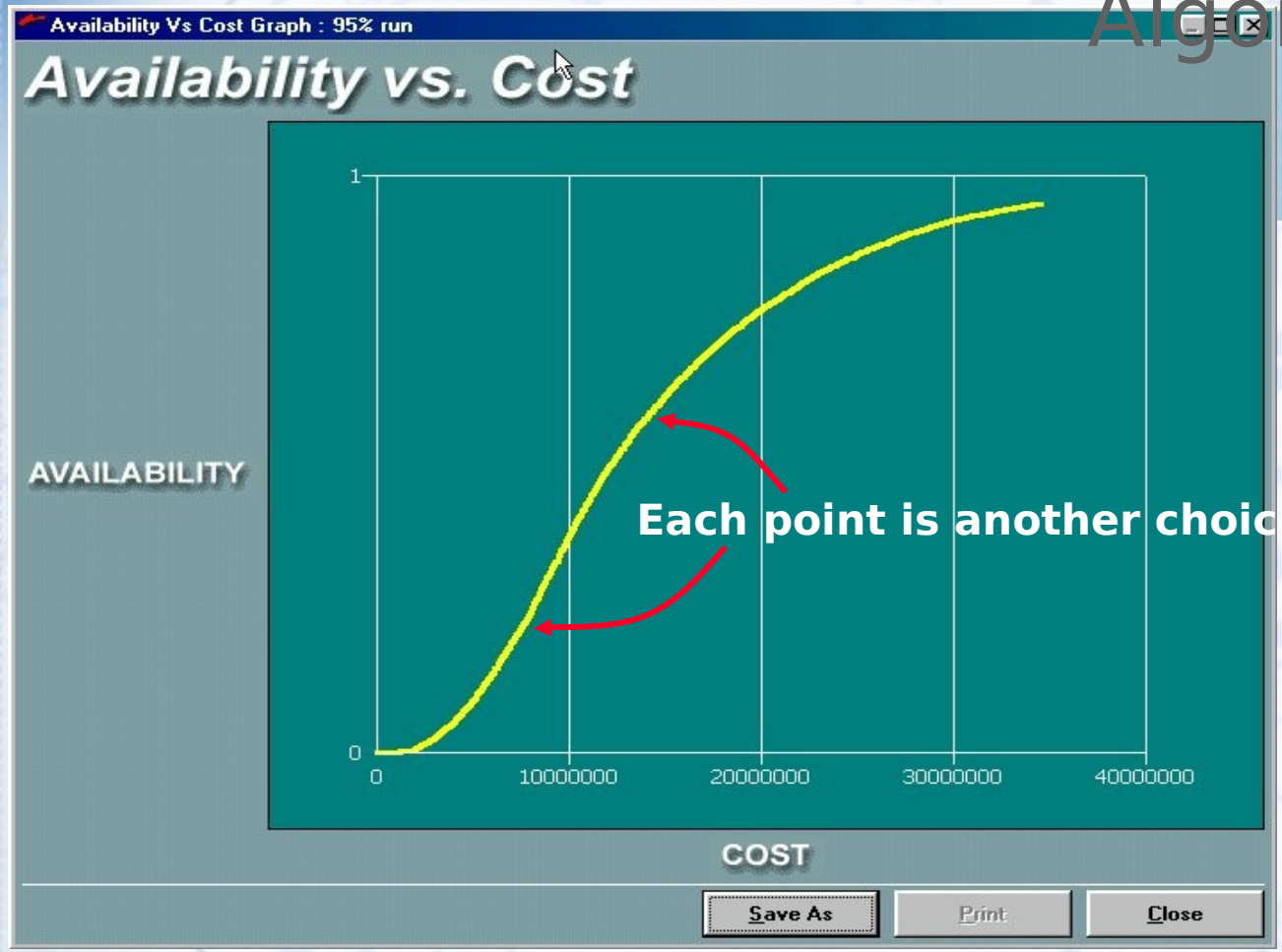
Operation of ***VMetric*** Algorithm



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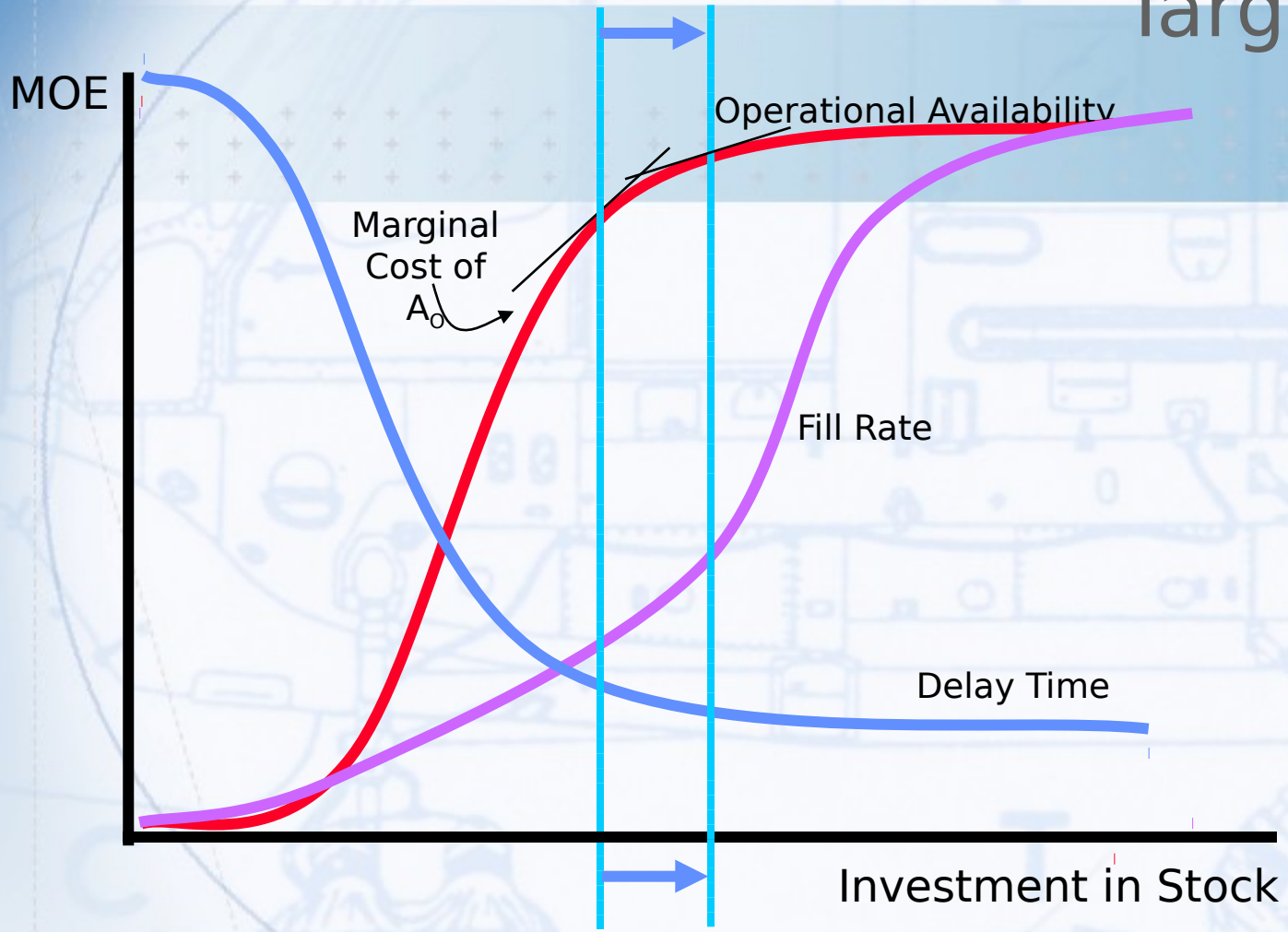
Alternative Operational Targets



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General Description of *VMetric*

General Attributes

- Uses Sherbrooke's calculating engine, based on his VARIMETRIC algorithm
  - 4th generation of work started at RAND in early '60s
  - Proved valid in experiments and by 35 years of use in more than ten countries
- Simple, powerful PC-based Windows© interface with spread-sheet data entry forms, graphics results
- Allows quick, easy input data variation for "what if?" questions and answers
  - Changes in support structure and attributes like delay times, operating location and pace, item data
- Provides full range of computations including recommended stock amounts and locations, operational goals, EOQ data

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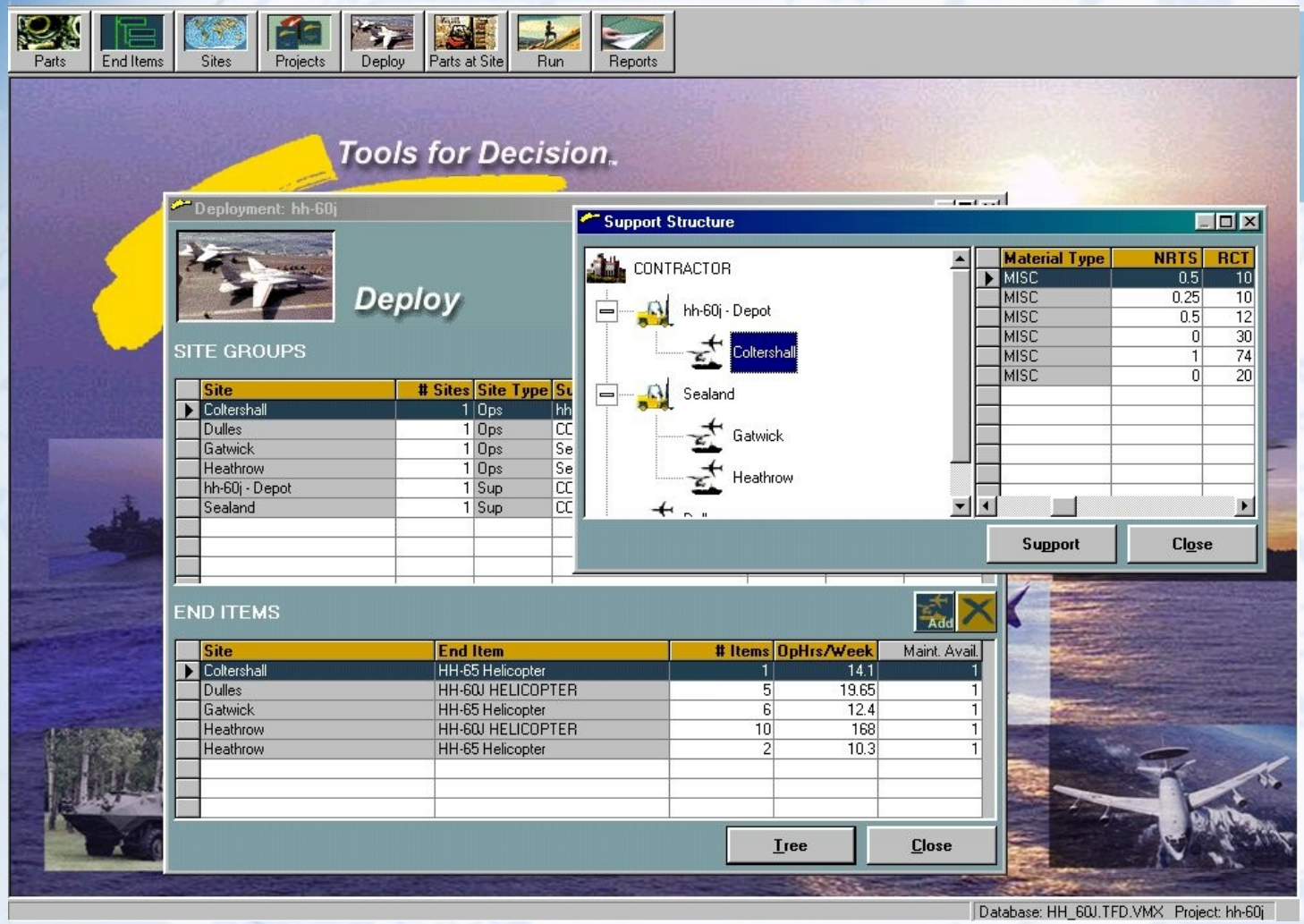
VMetric User Interface



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General Description of *VMetric*

Hardware and Support System Modeling

- Hardware System Modeling
  - Unlimited parts
  - Unlimited indenture levels in the hardware hierarchy
  - Fleet of fleets solutions (i.e. multiple system types)
- Support System Modeling
  - Unlimited operating bases
    - Each base may have different numbers and operating rates of each system type
    - Each base may have different repair rates and delay times
  - Unlimited support shops and hierarchical levels (echelons)
    - Shops may be specialized by material type (e.g. hydraulic, electronic)

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General Description of ***VMetric***

Operational Criteria and Objective Functions

- Budget constraint
- Fill rate (service level)
- Operational availability rate (Project or System)
- MOE slope (Availability increase per currency unit)
- Shortage cost
- Profit or net benefit
- Backorder rate (internal measure - delay time)

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General Description of *VMetric*

Consideration of Special Cases

- Common items (within and across system types)
- LRU redundancy
- Insurance items
- Lateral resupply
- Mechanical (wear-out) items
- Scheduled removals
- Special operating site constraints including weight and volume
- Individual part criticality
- Allows selective LRU cannibalization
- Accounts for less than perfect maintenance availability
- Considers net benefit or profit

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General Description of *VMetric*

Data Integration and Management

- Uses a TFD Database implementation for input and output data
  - Provides for permanent, secure storage of hardware-descriptive data
  - Facilitates integration with other data and ERP systems
- Can be integrated with other analytical tools
  - TFD software applications
  - Other commercial products
  - User-developed tools and processes (with defined inputs/outputs)
- Unlimited user-defined queries and reports
- Additional features can be added as required for specific problems

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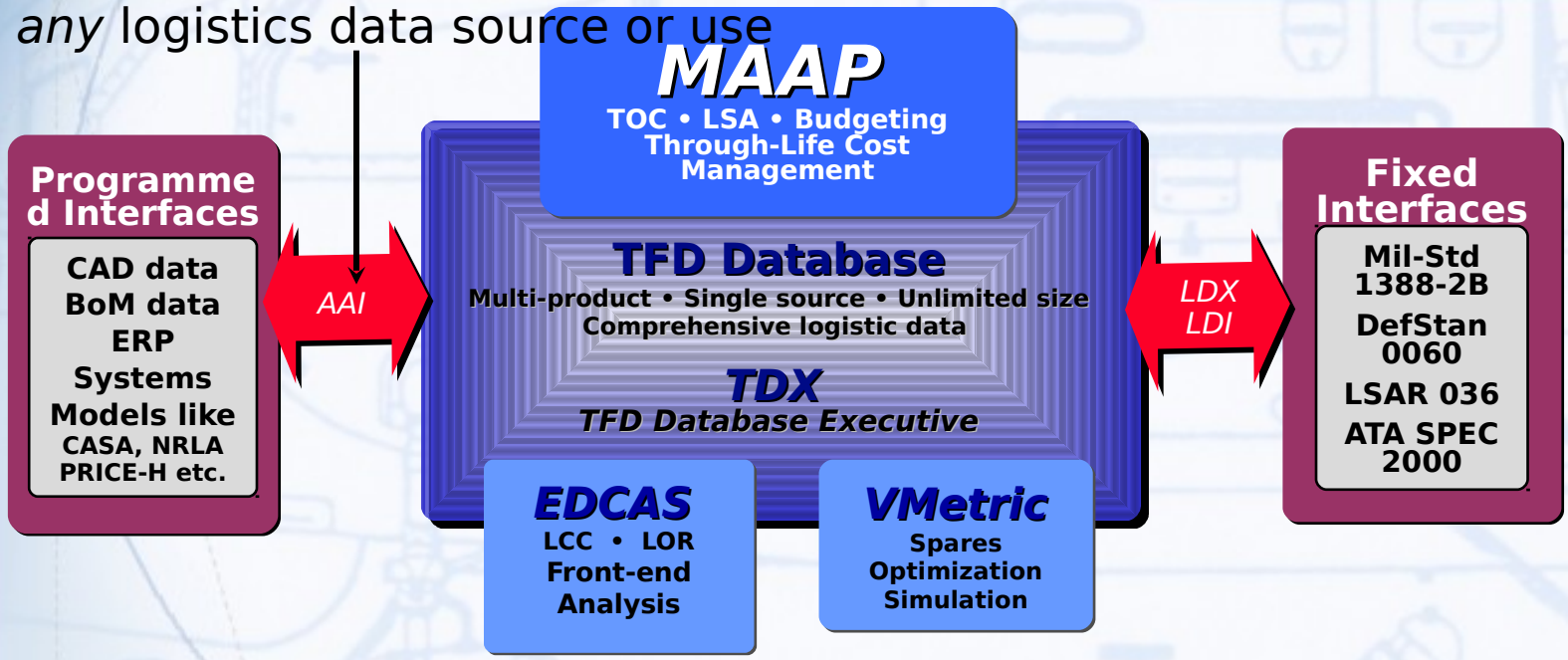
TFD Software Connectivity

The programmable interface, AAI, allows rapid, low cost interface with *any* logistics data source or use



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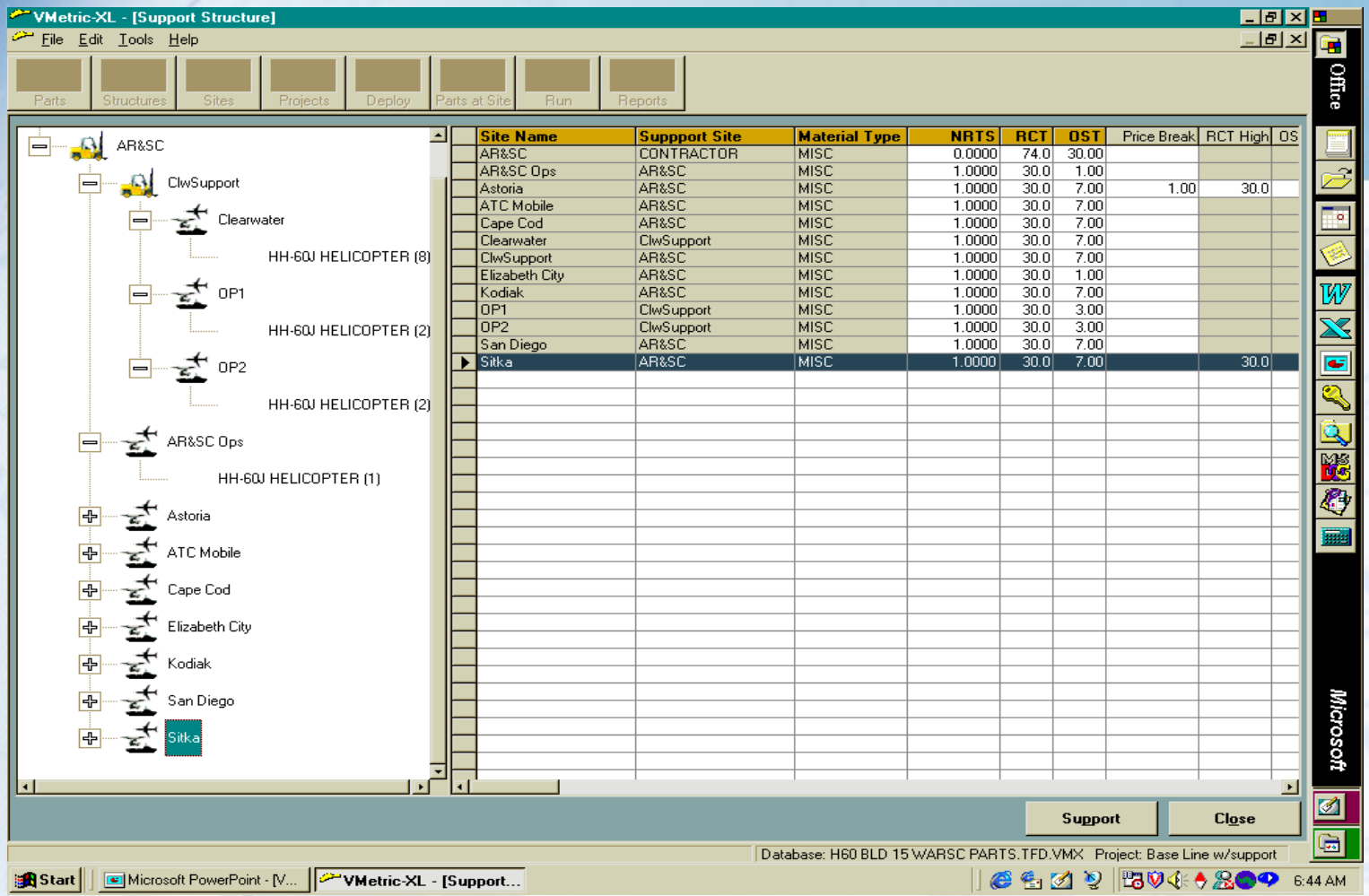
HH60 Support Structure


VMetric-XL - [Support Structure]
File Edit Tools Help
Parts
Structures
Sites
Projects
Deploy
Parts at Site
Run
Reports
AR&SC
ClwSupport
Clearwater
HH-60J HELICOPTER (8)
OP1
HH-60J HELICOPTER (2)
OP2
HH-60J HELICOPTER (2)
AR&SC Ops
HH-60J HELICOPTER (1)
Astoria
ATC Mobile
Cape Cod
Elizabeth City
Kodiak
San Diego
Sitka
Site Name | Suppport Site | Material Type | NRTS | RCT | OST | Price Break | RCT High | OS
AR&SC | CONTRACTOR | MISC | 0.0000 | 74.0 | 30.00
AR&SC Ops | AR&SC | MISC | 1.0000 | 30.0 | 1.00
Astoria | AR&SC | MISC | 1.0000 | 30.0 | 7.00 | 1.00 | 30.0
ATC Mobile | AR&SC | MISC | 1.0000 | 30.0 | 7.00
Cape Cod | AR&SC | MISC | 1.0000 | 30.0 | 7.00
Clearwater | ClwSupport | MISC | 1.0000 | 30.0 | 7.00
ClwSupport | AR&SC | MISC | 1.0000 | 30.0 | 7.00
Elizabeth City | AR&SC | MISC | 1.0000 | 30.0 | 1.00
Kodiak | AR&SC | MISC | 1.0000 | 30.0 | 7.00
OP1 | ClwSupport | MISC | 1.0000 | 30.0 | 3.00
OP2 | ClwSupport | MISC | 1.0000 | 30.0 | 3.00
San Diego | AR&SC | MISC | 1.0000 | 30.0 | 7.00
Sitka | AR&SC | MISC | 1.0000 | 30.0 | 7.00 | | 30.0
Support
Close
Database: H60 BLD 15 WARSC PARTS.TFD.VMX Project: Base Line w/support
Start
Microsoft PowerPoint - [V...
VMetric-XL - [Support...
6:44 AM
Office
Microsoft

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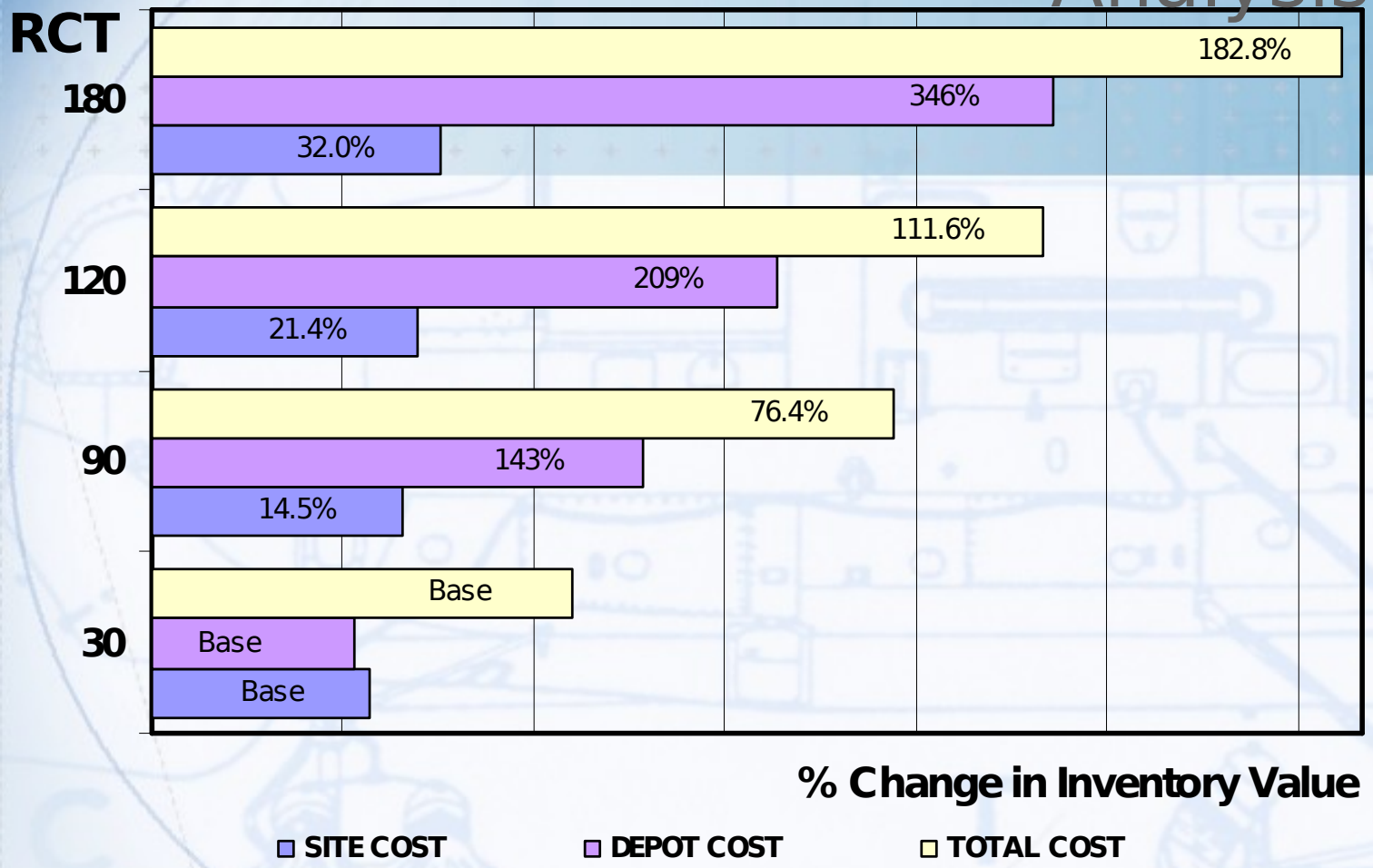
Depot Repair Cycle Time Analysis



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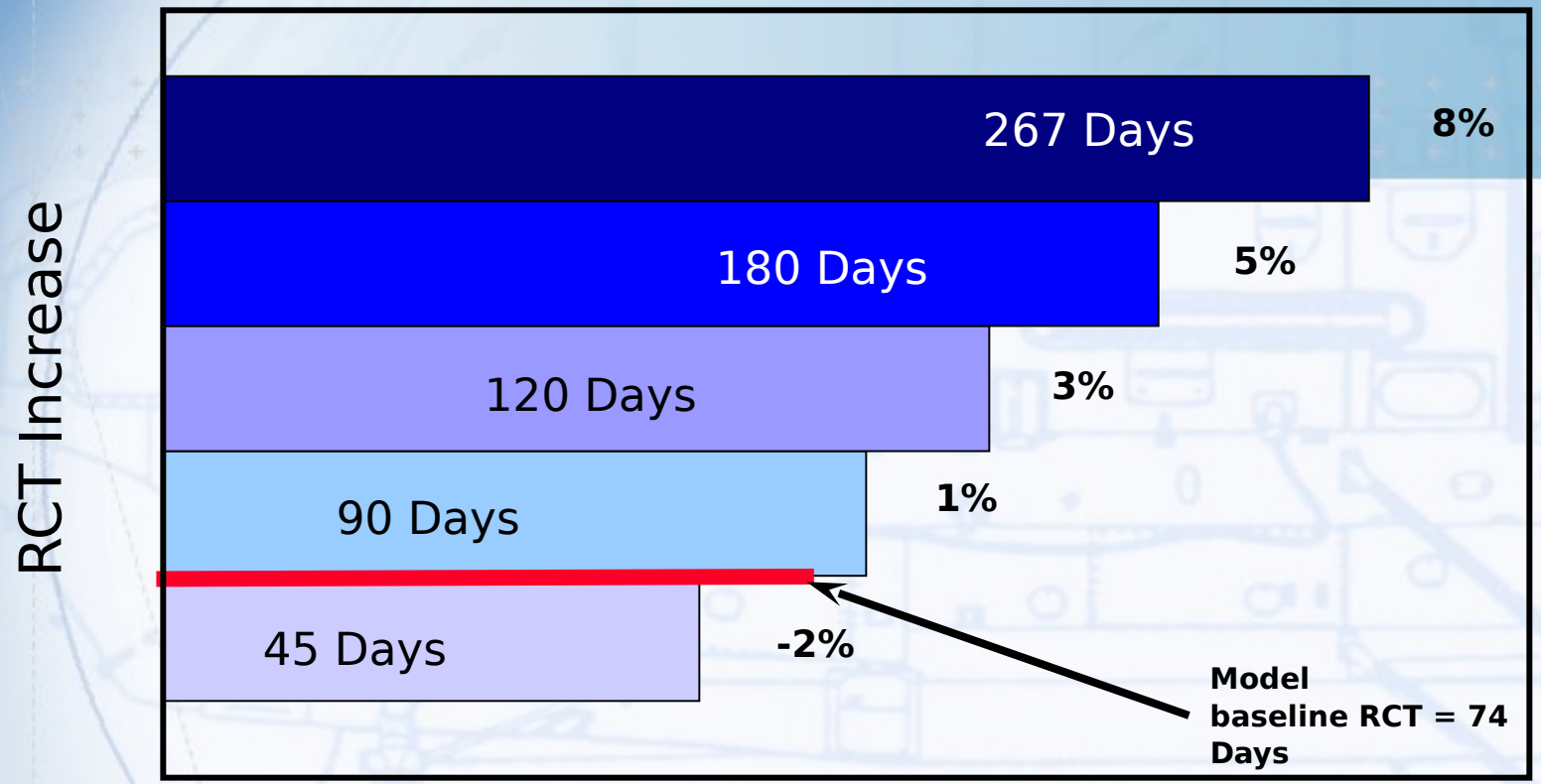
Single Item Impact Analysis



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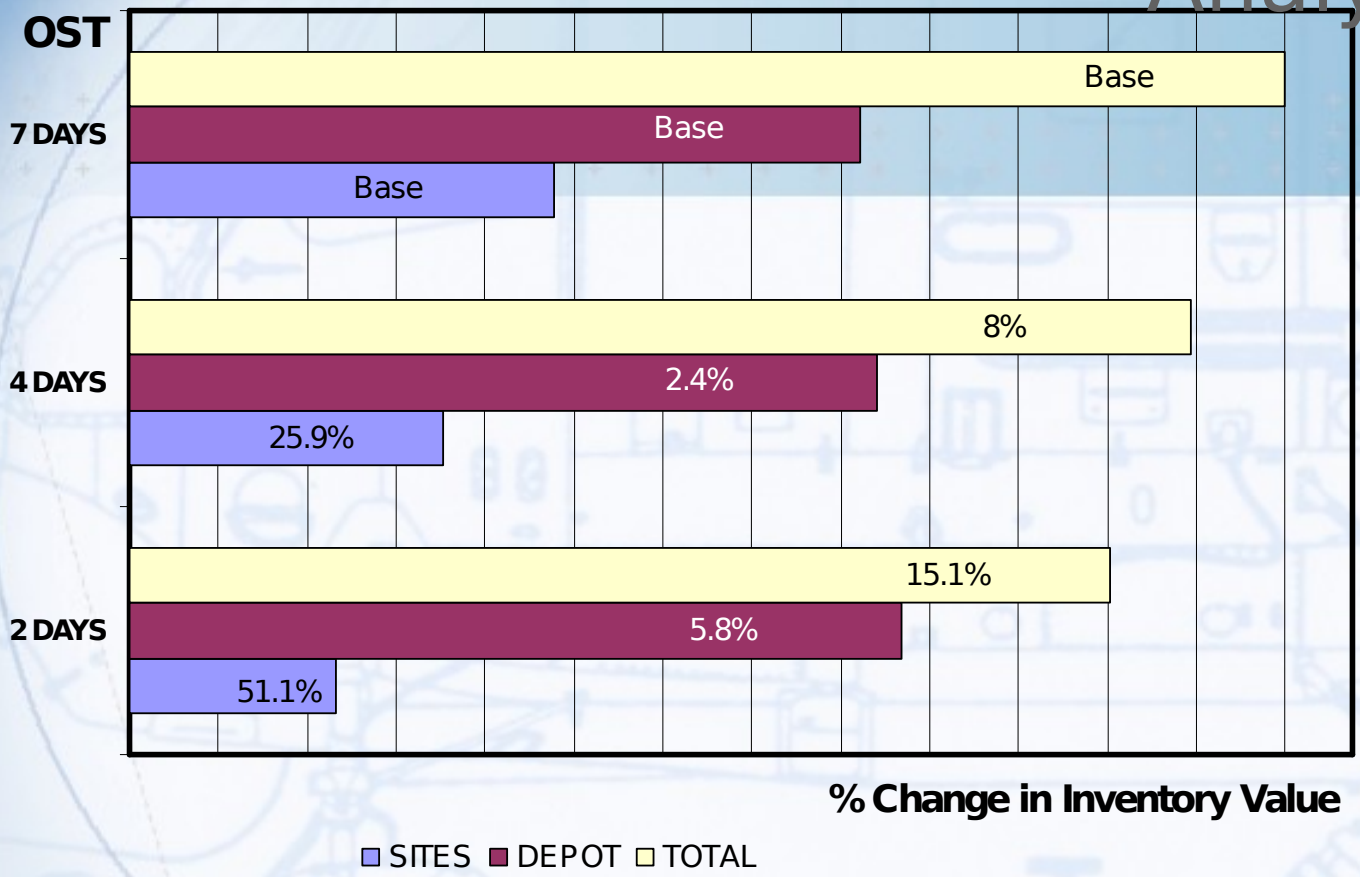
Wholesale Re-supply Analysis



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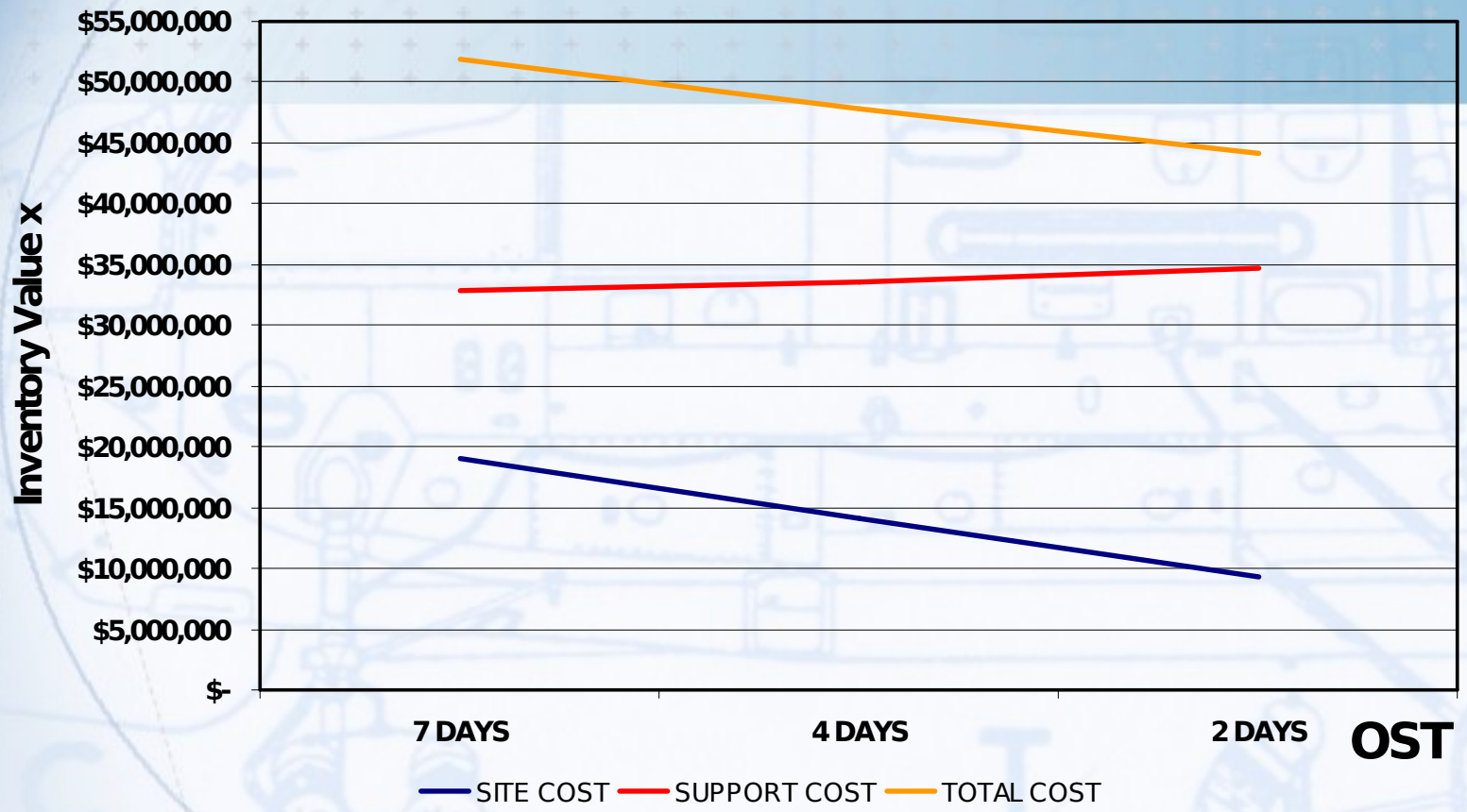
Wholesale Resupply Analysis



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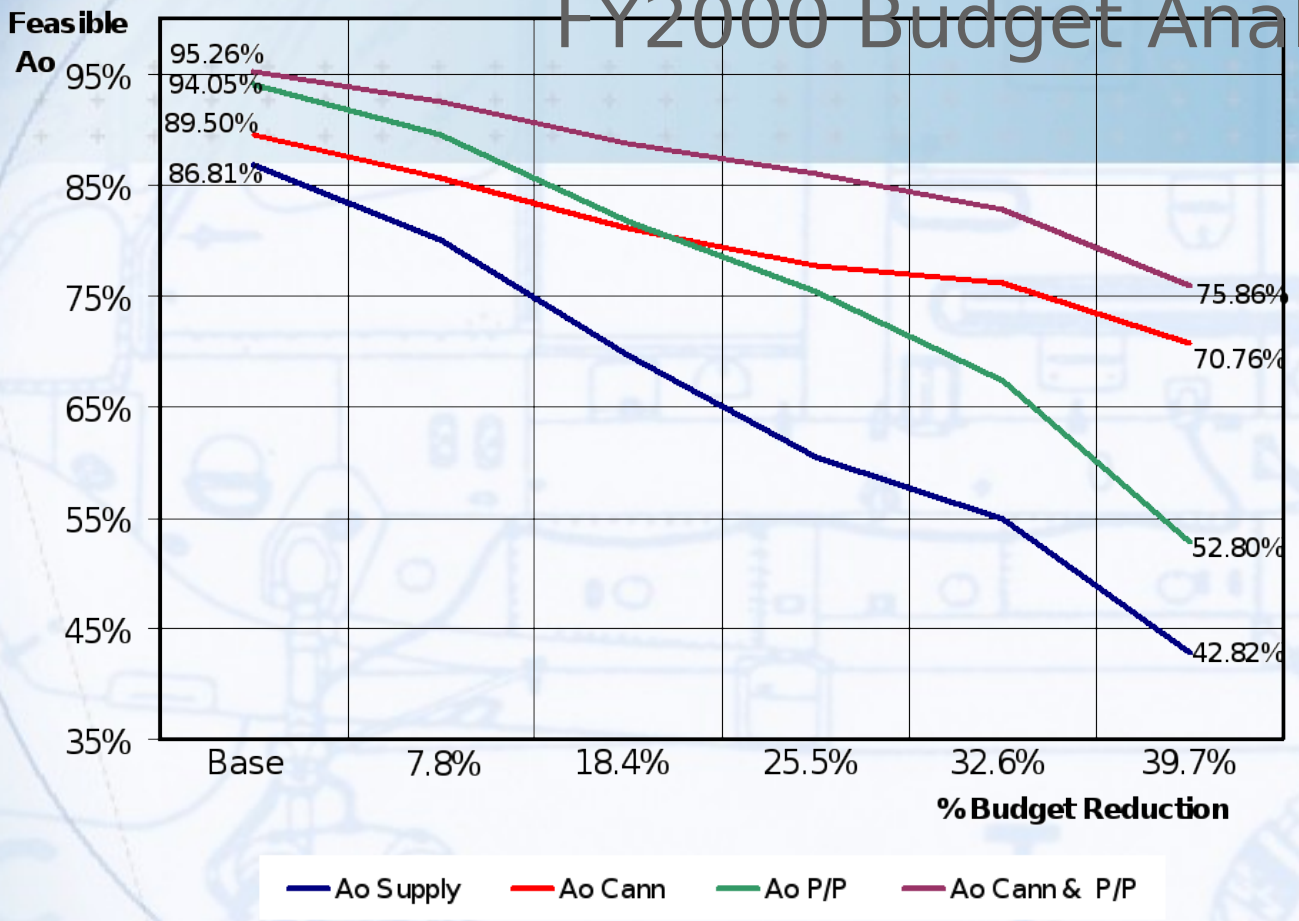
Effect of Under-Funding Spares
FY2000 Budget Analysis



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Why ***VMetric***?

- All other VARIMETRIC implementations are less advanced
  - Sherbrooke's articles, textbook and other versions now far behind current state of VMetric
- TFD version continues to advance
  - 35 engine builds in the past year alone
- No other version provides easy linkage with *all* other data sources and uses
- TFD Group has the experience to understand your special circumstances and requirements – and the staff to respond immediately, economically and intelligently

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